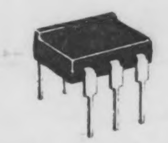
4N25
4N26
4N27
4N28*

NPN PHOTOTRANSISTOR AND PN INFRARED EMITTING DIODE

. . . Gallium Arsenide LED optically coupled to a Silicon Photo Transistor designed for applications requiring electrical isolation, high-current transfer ratios, small package size and low cost; such as interfacing and coupling systems, phase and feedback controls, solid-state relays and general-purpose switching circuits.

- High Isolation Voltage –
  V_{ISO} = 2500 V (Min) – 4N25
  1500 V (Min) – 4N26, 4N27
  500 V (Min) – 4N28
- High Collector Output Current
  @ I_F = 10 mA –
  I_C = 5.0 mA (Typ) – 4N25, 4N26
  3.0 mA (Typ) – 4N27, 4N28
- Economical, Compact, Dual-In-Line Package
- Excellent Frequency Response –
  300 kHz (Typ)
- Fast Switching Times @ I_C = 10 mA
  t_{on} = 0.87 μs (Typ) – 4N25, 4N26
  2.1 μs (Typ) – 4N27, 4N28
  t_{off} = 11 μs (Typ) – 4N25, 4N26
  5.0 μs (Typ) – 4N27, 4N28

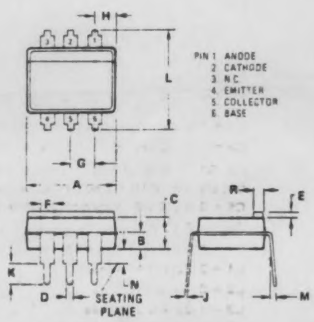
INFRARED LIGHT EMITTING DIODE PHOTOTRANSISTOR COUPLED PAIR



*MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
INFRARED EMITTING DIODE MAXIMUM RATINGS			
Reverse Voltage	V_R	3.0	Volts
Forward Current – Continuous	I_F	80	mA
Forward Current – Peak Pulse Width = 300 μs, 2.0% Duty Cycle	I_F	3.0	Amp
Total Device Dissipation @ T_A = 25°C Negligible Power in Transistor Derate above 25°C	P_D	150 2.0	mW mW/°C
PHOTOTRANSISTOR MAXIMUM RATINGS			
Collector-Emitter Voltage	V_{CEO}	30	Volts
Emitter-Collector Voltage	V_{ECO}	7.0	Volts
Collector-Base Voltage	V_{CBO}	70	Volts
Total Device Dissipation @ T_A = 25°C Negligible Power in Diode Derate above 25°C	P_D	150 2.0	mW mW/°C
TOTAL DEVICE RATINGS			
Total Device Dissipation @ T_A = 25°C Equal Power Dissipation in Each Element Derate above 25°C	P_D	250 3.3	mW mW/°C
Junction Temperature Range	T_J	-55 to +100	°C
Storage Temperature Range	T_{stg}	-55 to +150	°C
Soldering Temperature (10 s)		260	°C

*Indicates JEDEC Registered Data.



DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	8.38	8.89	0.330	0.350
B	1.40	1.65	0.055	0.065
C	2.92	3.18	0.115	0.125
D	0.41	0.51	0.016	0.020
E	0.64	0.89	0.025	0.035
F	1.14	1.40	0.045	0.055
G	2.54 BSC		0.100 BSC	
H	1.57	1.83	0.062	0.072
J	0.23	0.28	0.009	0.011
K	2.54	3.30	0.100	0.130
L	7.37	7.87	0.290	0.310
M	–	5°	–	5°
N	–	1.27	–	0.050
R	1.52	1.78	0.060	0.070

CASE 673-03

FIGURE 1 – MAXIMUM POWER DISSIPATION

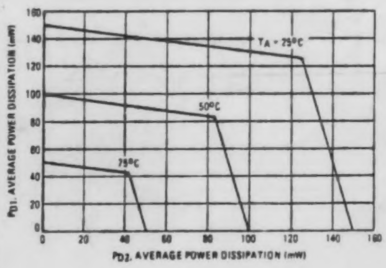


Figure 1 is based upon using limit values in the equation:

$T_{J1} - T_A = R_{\theta JA}(P_{D1} + K_\theta P_{D2})$

where:

T_{J1} Junction Temperature (100°C)
T_A Ambient Temperature
$R_{\theta JA}$ Junction to Ambient Thermal Resistance (500°C/W)
P_{D1} Power Dissipation in One Chip
P_{D2} Power Dissipation in Other Chip
K_θ Thermal Coupling Coefficient (20%)

Example:
With P_{D1} = 90 mW in the LED @ T_A = 50°C, the transistor P_D (P_{D2}) must be less than 50 mW.

LED CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
*Reverse Leakage Current (V_R = 3.0 V, R_L = 1.0 M ohms)	I_R	–	0.05	100	μA
*Forward Voltage (I_F = 50 mA)	V_F	–	1.2	1.5	Volts
Capacitance (V_R = 0 V, f = 1.0 MHz)	C	–	150	–	pF

PHOTOTRANSISTOR CHARACTERISTICS (T_A = 25°C and I_F = 0 unless otherwise noted)

Characteristic		Symbol	Min	Typ	Max	Unit
*Collector-Emitter Dark Current (V_{CE} = 10 V, Base Open)	4N25, 4N26, 4N27 4N28	I_{CEO}	 –	3.5 –	50 100	nA
*Collector-Base Dark Current (V_{CB} = 10 V, Emitter Open)		I_{CBO}	–	–	20	nA
*Collector-Base Breakdown Voltage (I_C = 100 μA, I_E = 0)		BV_{CBO}	70	–	–	Volts
*Collector-Emitter Breakdown Voltage (I_C = 1.0 mA, I_B = 0)		BV_{CEO}	30	–	–	Volts
*Emitter-Collector Breakdown Voltage (I_E = 100 μA, I_B = 0)		BV_{ECO}	7.0	–	–	Volts
DC Current Gain (V_{CE} = 5.0 V, I_C = 500 μA)		h_{FE}	–	250	–	–

COUPLED CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Typ	Max	Unit
*Collector Output Current (1) (V_{CE} = 10 V, I_F = 10 mA, I_B = 0)	4N25,4N26 4N27,4N28	I_C	2.0 1.0	5.0 3.0	– –	mA
*Isolation Voltage (2)	4N25 4N26,4N27 4N28	V_{ISO}	2500 1500 500	– – –	– – –	Volts
Isolation Resistance (2) (V = 500 V)				10^{11}	–	Ohms
*Collector-Emitter Saturation (I_C = 2.0 mA, I_F = 50 mA)		$V_{CE(sat)}$		0.2	0.5	Volts
Isolation Capacitance (2) (V = 0, f = 1.0 MHz)		–		1.3	–	pF
Bandwidth (3) (I_C = 2.0 mA, R_L = 100 ohms, Figure 11)				300	–	kHz

SWITCHING CHARACTERISTICS

Delay Time	(I_C = 10 mA, V_{CC} = 10 V)	4N25,4N26 4N27,4N28	t_d	–	0.07 0.10	– –	μs
Rise Time	Figures 6 and 8	4N25,4N26 4N27,4N28	t_r	– –	0.8 2.0	– –	μs
Storage Time	(I_C = 10 mA, V_{CC} = 10 V)	4N25,4N26 4N27,4N28	t_s	– –	4.0 2.0	– –	μs
Fall Time	Figures 7 and 8	4N25,4N26 4N27,4N28	t_f	– –	7.0 3.0	– –	μs

*Indicates JEDEC Registered Data (1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%
(2) For this test LED pins 1 and 2 are common and Photo Transistor pins 4, 5 and 6 are common.
(3) I_F adjusted to yield I_C = 2.0 mA and i_c = 2.0 mA p-p at 10 kHz

DC CURRENT TRANSFER CHARACTERISTICS

FIGURE 2 – 4N25, 4N26

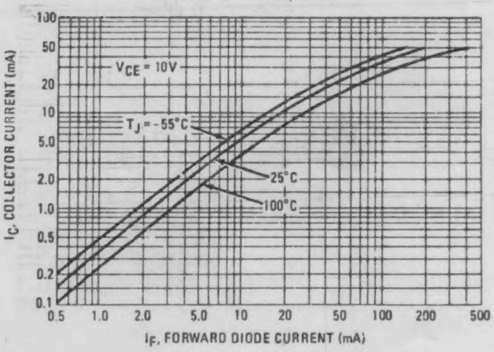
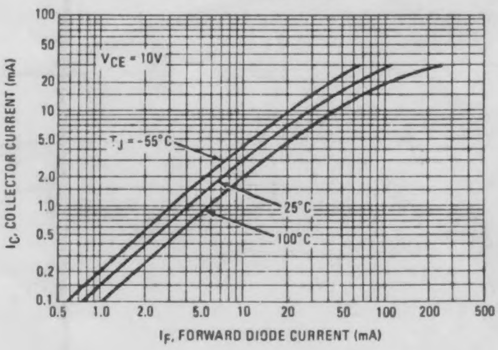


FIGURE 3 – 4N27, 4N28



TYPICAL ELECTRICAL CHARACTERISTICS

FIGURE 4 – DIODE FORWARD CHARACTERISTICS

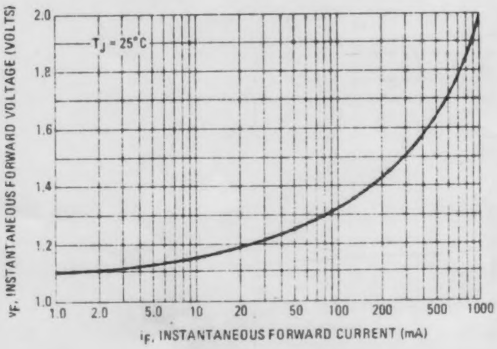


FIGURE 5 – COLLECTOR SATURATION VOLTAGE

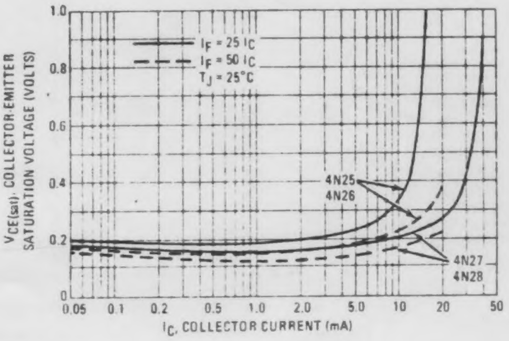


FIGURE 6 – TURN-ON TIME

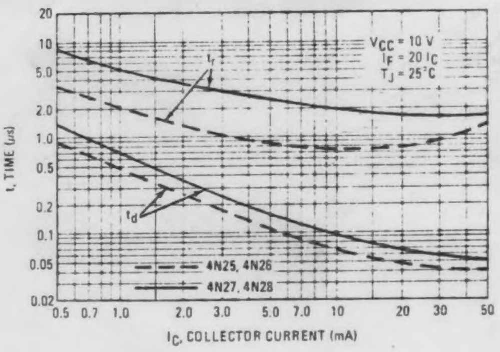


FIGURE 7 – TURN-OFF TIME

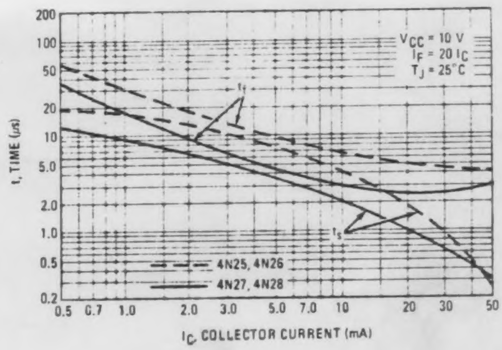


FIGURE 8 – SATURATED SWITCHING TIME TEST CIRCUIT

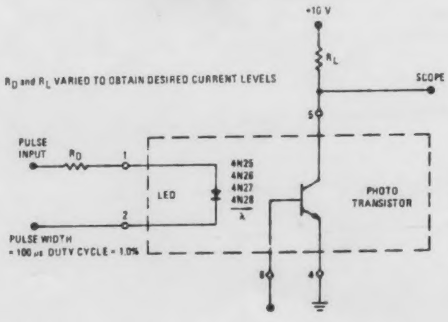


FIGURE 9 – DARK CURRENT versus AMBIENT TEMPERATURE

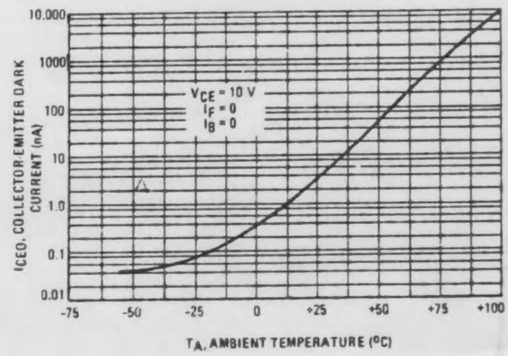


FIGURE 10 – FREQUENCY RESPONSE

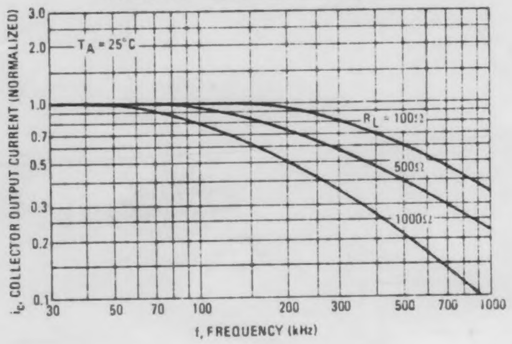
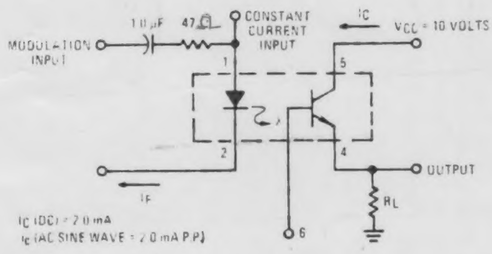


FIGURE 11 – FREQUENCY RESPONSE TEST CIRCUIT



TYPICAL APPLICATIONS

FIGURE 12 – ISOLATED MTTL TO MOS (P-CHANNEL) LEVEL TRANSLATOR

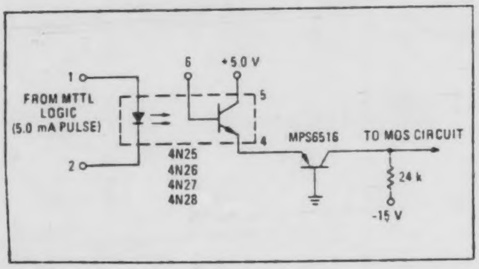


FIGURE 13 – COMPUTER/PERIPHERAL INTERCONNECT

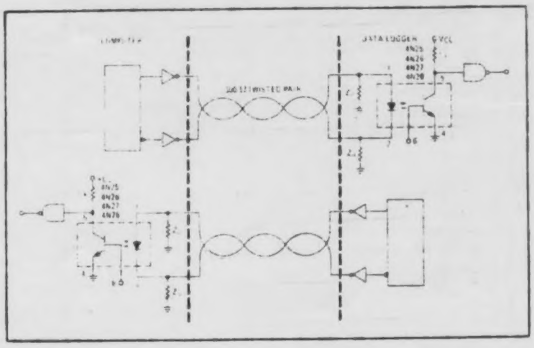


FIGURE 14 – POWER AMPLIFIER

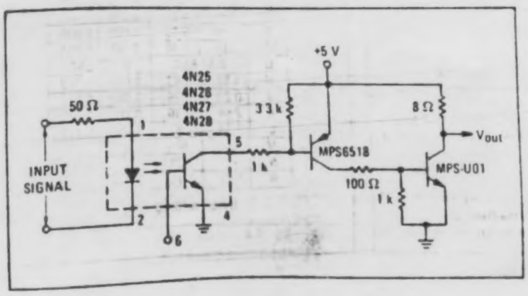
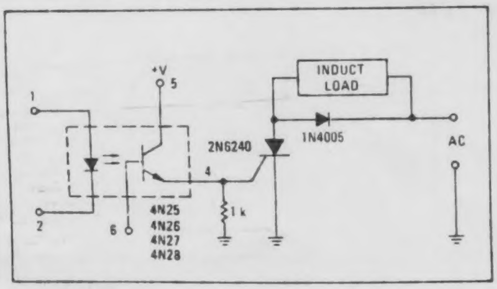


FIGURE 15 – INTERFACE BETWEEN LOGIC AND LOAD



Typical Electrical Characteristics

4N35
4N36
4N37

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F*	Forward Voltage	0.8		1.5	V	$I_F = 10$ mA
I_R*	Reverse Leakage Current		0.01	10	μA	$V_R = 6.0$ V
C	Capacitance			100	pF	$V_R = 0$ V f = 1 MHz

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}*	Collector-to-Emitter Voltage	30	65		V	$I_C = 10$ mA
V_{CBO}*	Collector-to-Base Voltage	70	165		V	$I_C = 100\ \mu$A
V_{ECO}*	Emitter-to-Collector Voltage	7.0	14		V	$I_E = 100\ \mu$A, $I_F = 0$
I_{CEO}*	Collector-to-Emitter Leakage Current		5.0	50	nA	$V_{CE} = 10$ V, $I_F = 0$
I_{CEO}*	Collector-to-Emitter Leakage Current			500	μA	$V_{CE} = 30$ V, $I_F = 0$, $T_A = 100°C$
h_{FE}	Forward Current Gain	100	250			$V_{CE} = 5.0$ V, $I_C = 100\ \mu$A
C_{cb}	Collector-to-Base Capacitance		25		pF	$V_{CB} = 10$ V

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
I_{IO}*	Input-to-Output Current					PW = 8 ms
	4N35			100	μA	$V_{IO} = 3550$ V
	4N36			100	μA	$V_{IO} = 2500$ V
	4N37			100	μA	$V_{IO} = 1500$ V
$V_{CE(sat)}$*	Collector-to-Emitter Saturation Voltage			0.3	V	$I_C = 0.5$ mA, $I_F = 10$ mA
I_C/I_F(CTR)*	Collector Current Transfer Ratio (Note)	100			%	$V_{CE} = 10$ V, $I_F = 10$ mA
I_C/I_F(CTR)*	Collector Current Transfer Ratio (Note)	40			%	$V_{CE} = 10$ V, $I_F = 10$ mA, $T_A = -55°C$ to 100°C
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.0	2.5	pF	$V_{IO} = 0$, f = 1.0 MHz
t_{on}	Turn-on Time		5.0	10	μs	$I_C = 2.0$ mA, $V_{CC} = 10$ V, $R_L = 100\ \Omega$
t_{off}	Turn-off Time		5.0	10	μs	$I_C = 2.0$ mA, $V_{CC} = 10$ V, $R_L = 100\ \Omega$

Notes
Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
*Indicates JEDEC registered values.

LSTTL/T
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Optoelectronic Pr

General Descrip
The 6N137 optoc
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The 6N137 is ap
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Up to 70°C)

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Maximum Pow
Output Collecto
Dissipation

*JEDEC Registered

Optically-Coupled Isolator

Optoelectronic Products

4N35
4N36
4N37

General Description

The 4N35, 4N36 and 4N37 series of optoisolators has a silicon npn Planar phototransistor in close proximity to a GaAs diode. Optical coupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the transistor base is also provided for design flexibility. This isolator series is covered under UL component recognition program, reference file E55299.

- Glassolated™
- High Current Transfer Ratio—Minimum 100%
- 1500 V to 3500 V Minimum Isolation Input-to-Output
- $10^{11}\ \Omega$ Isolation Resistance
- Low Coupling Capacitance—Typically 1.0 pF

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature*	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 10 s)*	260°C
Relative Humidity at 85°C*	85%

Input Diode

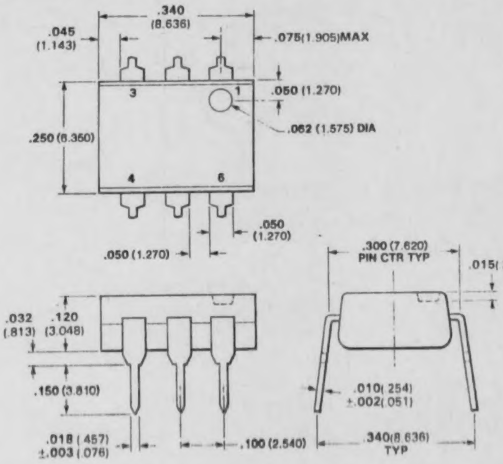
V_R*	Reverse Voltage	6.0 V
I_F*	Forward Current	60 mA
I_{pk}*	Peak Forward Current at 1 μs pulse width, 300 pps	3.0 A
P_D*	Power Dissipation at $T_A = 25°C$	100 mW
	Derate Linearly from 25°C	1.33 mW/°C

Output Transistor

V_{CE}*	Collector-to-Emitter Voltage	30 V
V_{CB}*	Collector-to-Base Voltage	70 V
V_{EC}*	Emitter-to-Collector Voltage	7.0 V
I_C*	Collector Current	100 mA
P_D*	Power Dissipation at $T_A = 25°C$	300 mW
	Derate Linearly from 25°C	4.0 mW/°C

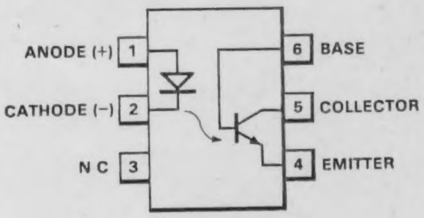
*Indicates JEDEC registered values.

Package Outline



Notes
All dimension in inches bold and millimeters (parentheses)
Tolerance unless specified = ±0.15 (0.381)

Connection Diagram
DIP (Top View)



Pin		
1	Anode (+)	Input Diode
2	Cathode (−)	Input Diode
3	NC	Output npn Phototransistor
4	Emitter	Output npn Phototransistor
5	Collector	Output npn Phototransistor
6	Base	Output npn Phototransistor

BULLETIN NO. DL-S 7312030, NOVEMBER 1973

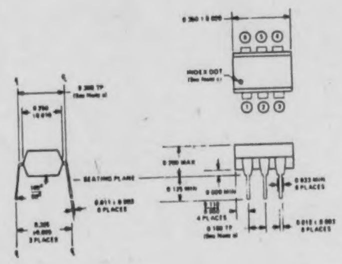
COMPATABLE WITH STANDARD DTL AND TTL INTEGRATED CIRCUITS

- Gallium Arsenide Diode Infrared Source Optically Coupled to a Silicon N-P-N Phototransistor
- High Direct-Current Transfer Ratio
- Base Lead Provided for Conventional Transistor Biasing
- High-Voltage Electrical Isolation . . . 1.5-kV or 2.5-kV Rating
- Plastic Dual-In-Line Package
- High-Speed Switching: $t_r = 2\ \mu s$, $t_f = 2\ \mu s$ Typical

5

mechanical data

The package consists of a gallium arsenide infrared-emitting diode and an n-p-n silicon phototransistor mounted on a 6-lead frame encapsulated within an electrically nonconductive plastic compound. The case will withstand soldering temperature with no deformation and device performance characteristics remain stable when operated in high-humidity conditions. Unit weight is approximately 0.52 grams.



NOTES:
a. Leads are within 0.005 radius of true position (TP) at the gauge plane with maximum material condition and unit installed.
b. All dimensions are in inches unless otherwise noted.
c. Pin 1 identified by index dot.
d. Terminal connections:
1. Anode
2. Cathode
} Infrared-emitting diode
3. No internal connection
4. Emitter
5. Collector
6. Base
} Phototransistor

absolute maximum ratings at 25°C free-air temperature (unless otherwise noted)

Input-to-Output Voltage: TIL111	±1.5 kV
TIL114, TIL116, TIL117	±2.5 kV
Collector-Base Voltage	70 V
Collector-Emitter Voltage (See Note 1)	30 V
Emitter-Collector Voltage	7 V
Emitter-Base Voltage	7 V
Input-Diode Reverse Voltage	3 V
Input-Diode Continuous Forward Current at (or below) 25°C Free-Air Temperature (See Note 2)	100 mA
Continuous Power Dissipation at (or below) 25°C Free-Air Temperature:	
Infrared-Emitting Diode (See Note 3)	150 mW
Phototransistor (See Note 4)	150 mW
Total, Infrared-Emitting Diode plus Phototransistor (See Note 5)	250 mW
Storage Temperature Range	−55°C to 150°C
Lead Temperature 1/16 Inch from Case for 10 Seconds	260°C

NOTES:
1. This value applies when the base-emitter diode is open-circuited.
2. Derate linearly to 100°C free-air temperature at the rate of 1.33 mA/°C.
3. Derate linearly to 100°C free-air temperature at the rate of 2 mW/°C.
4. Derate linearly to 100°C free-air temperature at the rate of 2 mW/°C.
5. Derate linearly to 100°C free-air temperature at the rate of 3.33 mW/°C.

electrical characteristics at 25°C free-air temperature

PARAMETER			TEST CONDITIONS	TIL111 TIL114 MIN	TIL111 TIL114 TYP	TIL111 TIL114 MAX	TIL116 MIN	TIL116 TYP	TIL116 MAX	TIL117 MIN	TIL117 TYP	TIL117 MAX	UNIT
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage		$I_C = 10\ \mu A$, $I_E = 0$, $I_F = 0$	70			70			70			V
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage		$I_C = 1$ mA, $I_B = 0$, $I_F = 0$	30			30			30			V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage		$I_E = 10\ \mu A$, $I_C = 0$, $I_F = 0$	7			7			7			V
I_R	Input Diode Static Reverse Current		$V_R = 3$ V			10			10			10	µA
$I_{C(on)}$	On-State Collector Current	Phototransistor Operation	$V_{CE} = 0.4$ V, $I_F = 16$ mA, $I_B = 0$	2	7								mA
			$V_{CE} = 10$ V, $I_F = 10$ mA, $I_B = 0$				2	5		5	9		mA
		Photodiode Operation	$V_{CB} = 0.4$ V, $I_F = 16$ mA, $I_E = 0$	10	20		10	20		10	20		µA
$I_{C(off)}$	Off-State Collector Current	Phototransistor Operation	$V_{CE} = 10$ V, $I_F = 0$, $I_B = 0$		1	50		1	50		1	50	nA
		Photodiode Operation	$V_{CB} = 10$ V, $I_F = 0$, $I_E = 0$		0.1	20		0.1	20		0.1	20	nA
h_{FE}	Transistor Static Forward Current Transfer Ratio		$V_{CE} = 5$ V, $I_C = 10$ mA, $I_F = 0$	100	300					200	550		
			$V_{CE} = 5$ V, $I_C = 100\ \mu A$, $I_F = 0$				100	300					
V_F	Input Diode Static Forward Voltage		$I_F = 16$ mA		1.2	1.4					1.2	1.4	V
			$I_F = 60$ mA					1.25	1.5				V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		$I_C = 2$ mA, $I_F = 16$ mA, $I_B = 0$		0.25	0.4							V
			$I_C = 2.2$ mA, $I_F = 15$ mA, $I_B = 0$					0.25	0.4				V
			$I_C = 0.5$ mA, $I_F = 10$ mA, $I_B = 0$								0.25	0.4	V
r_{IO}	Input-to-Output Internal Resistance		$V_{in-out} = \pm 1.5$ kV for TIL111, ± 2.5 kV for all others, See Note 6	10^{11}			10^{11}			10^{11}			Ω
C_{io}	Input-to-Output Capacitance		$V_{in-out} = 0$, f = 1 MHz, See Note 6		1	1.3		1	1.3		1	1.3	pF

NOTE 6: These parameters are measured between both input-diode leads shorted together and all the phototransistor leads shorted together.

switching characteristics at 25°C free-air temperature

PARAMETER			TEST CONDITIONS	TIL111 TIL114 MIN	TIL111 TIL114 TYP	TIL111 TIL114 MAX	TIL116 MIN	TIL116 TYP	TIL116 MAX	TIL117 MIN	TIL117 TYP	TIL117 MAX	UNIT
t_r	Rise Time	Phototransistor Operation	$V_{CC} = 10$ V, $I_{C(on)} = 2$ mA, $R_L = 100\ \Omega$, See Test Circuit A of Figure 1		2	5		2	7		2	9	µs
t_f	Fall Time				2	5		2	7		2	9	µs
t_r	Rise Time	Photodiode Operation	$V_{CC} = 10$ V, $I_{C(on)} = 20\ \mu A$, $R_L = 1$ kΩ, See Test Circuit B of Figure 1		1			1			1		µs
t_f	Fall Time				1			1			1		µs

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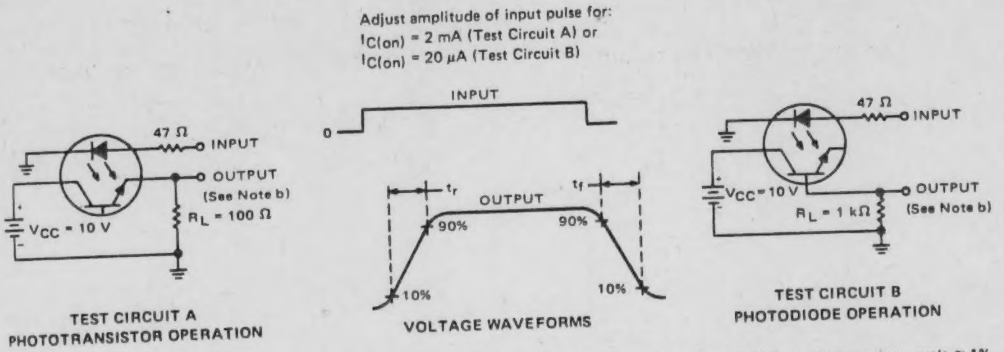
PARAMETER MEASUREMENT INFORMATION



NOTES: a. The input waveform is supplied by a generator with the following characteristics: Z_{out} = 50 Ω, $t_r \leq$ 15 ns, duty cycle ≈ 1%, t_w = 100 μs.

b. The output waveform is monitored on an oscilloscope with the following characteristics: $t_r \leq$ 12 ns, $R_{in} \geq$ 1 MΩ, $C_{in} \leq$ 20 pF.

FIGURE 1–SWITCHING TIMES

TYPICAL CHARACTERISTICS

TIL111, TIL114

COLLECTOR CURRENT
vs
INPUT-DIODE FORWARD CURRENT

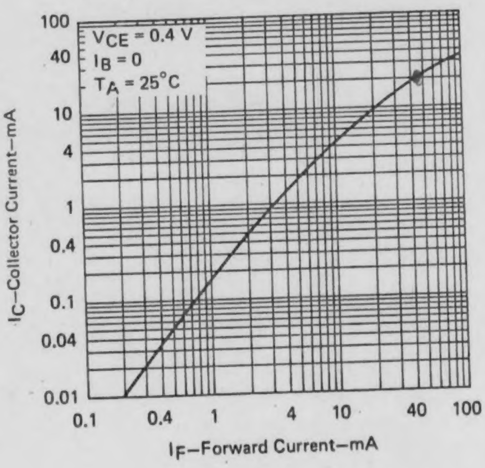


FIGURE 2

TIL116, TIL117

COLLECTOR CURRENT
vs
INPUT-DIODE FORWARD CURRENT

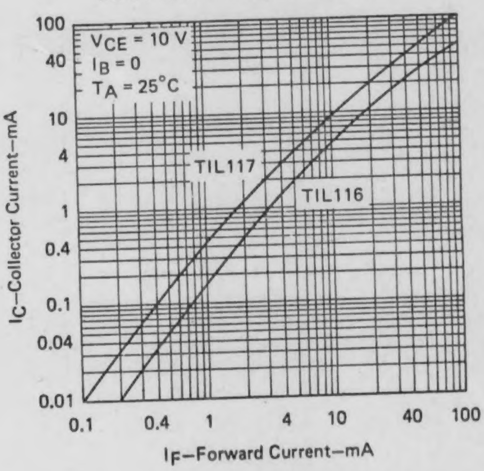


FIGURE 3

TYPICAL CHARACTERISTICS

TIL111, TIL114

COLLECTOR CURRENT
vs
COLLECTOR-EMITTER VOLTAGE

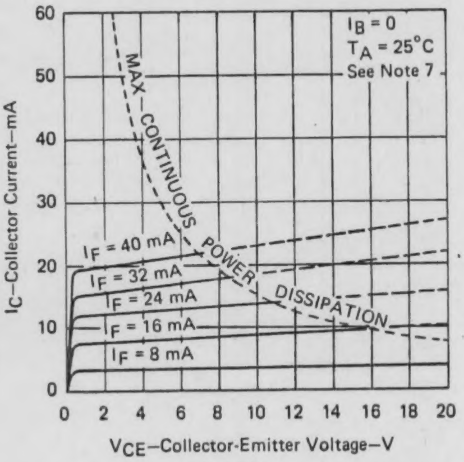


FIGURE 4

TIL116

COLLECTOR CURRENT
vs
COLLECTOR-EMITTER VOLTAGE

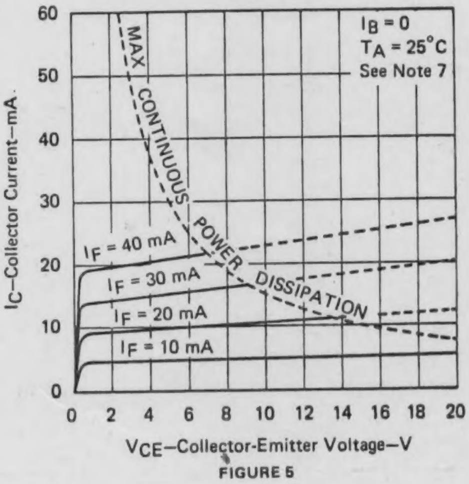


FIGURE 5

TIL117

COLLECTOR CURRENT
vs
COLLECTOR-EMITTER VOLTAGE

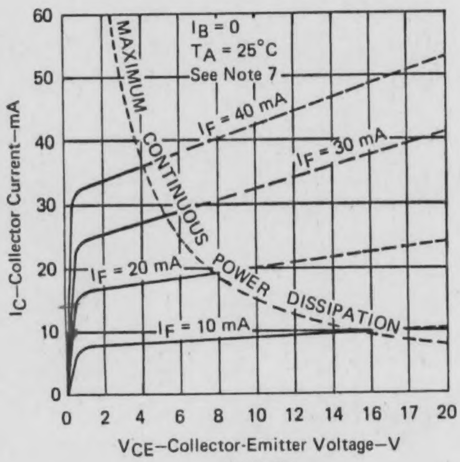


FIGURE 6

RELATIVE ON-STATE COLLECTOR CURRENT
vs
FREE-AIR TEMPERATURE

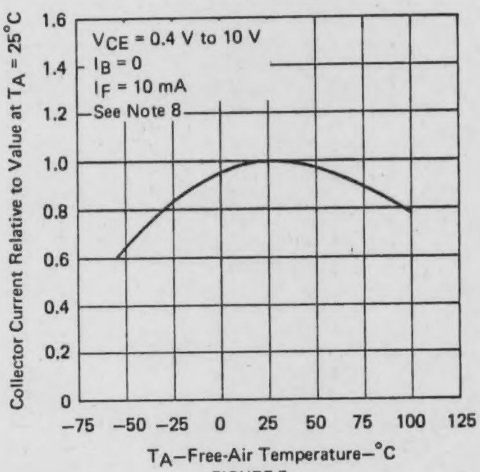
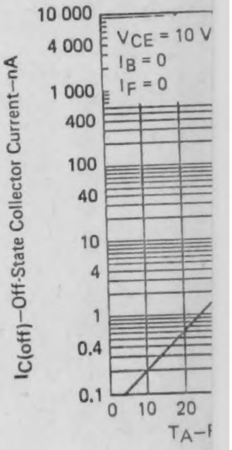


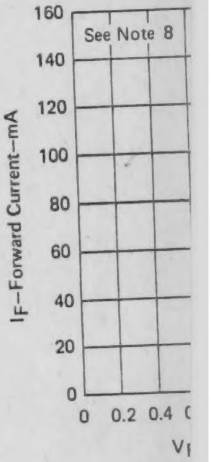
FIGURE 7

NOTES: 7. Pulse operation of input diode is required for operation beyond limits shown by dotted lines.
8. These parameters were measured using pulse techniques. t_w = 1 ms, duty cycle ≤ 2%.

OFF-STA
FREE



INPU
CONDUCT



NOTE 8: These paramete

TYPICAL CHARACTERISTICS

OFF-STATE COLLECTOR CURRENT
vs
FREE-AIR TEMPERATURE

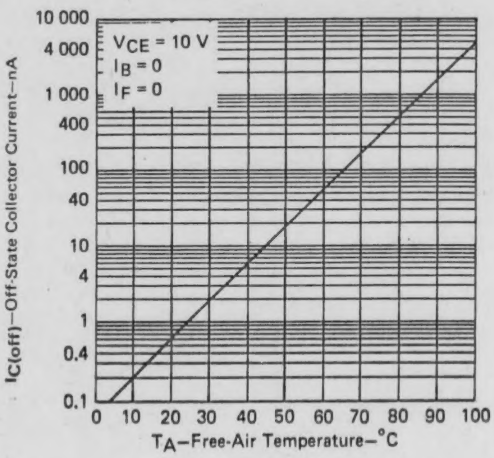


FIGURE 8

NORMALIZED TRANSISTOR STATIC FORWARD
CURRENT TRANSFER RATIO
vs
ON-STATE COLLECTOR CURRENT

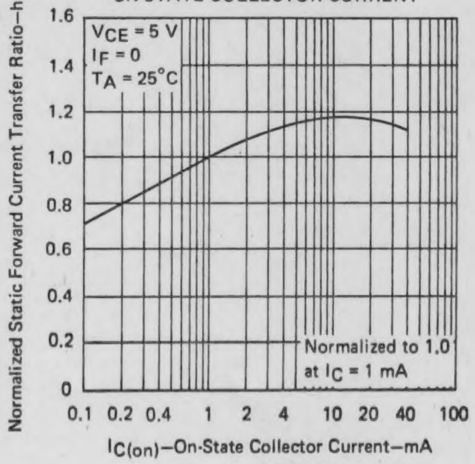


FIGURE 9

INPUT DIODE FORWARD
CONDUCTION CHARACTERISTICS

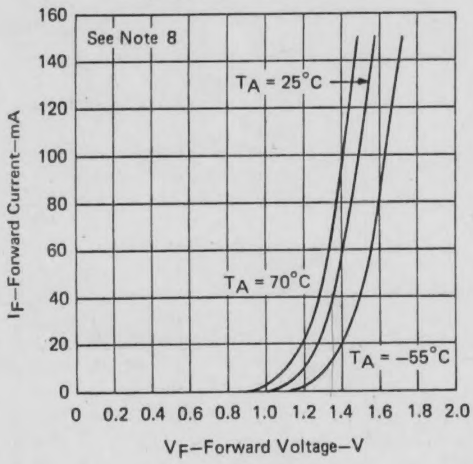


FIGURE 10

COLLECTOR CURRENT
vs
MODULATION FREQUENCY

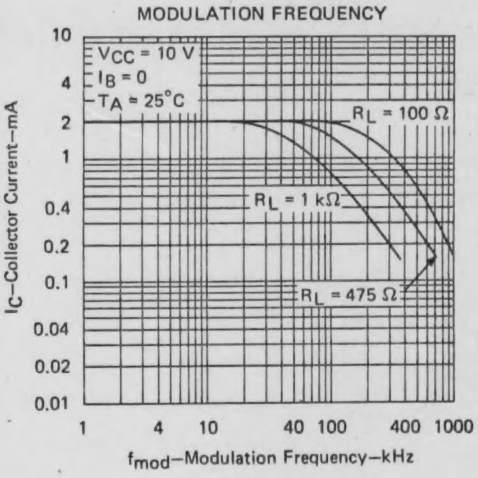


FIGURE 11

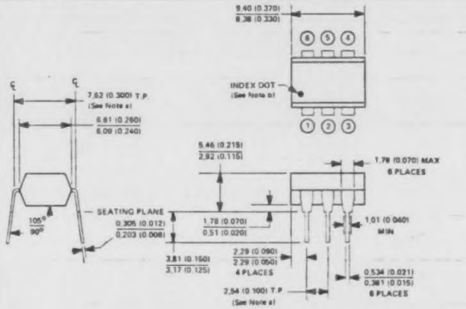
NOTE 8: These parameters were measured using pulse techniques. t_w = 1 ms, duty cycle ≤ 2%.

D1607, NOVEMBER 1973–REVISED FEBRUARY 1983

- Gallium Arsenide Diode Infrared Source Optically Coupled to a Silicon N-P-N Phototransistor
- High Direct-Current Transfer Ratio
- Base Lead Provided for Conventional Transistor Biasing (TIL112, TIL115)
- High-Voltage Electrical Isolation . . . 1.5-kV or 2.5-kV Rating
- Plastic Dual-In-Line Package
- High-Speed Switching: $t_r = 2\ \mu s$, $t_f = 2\ \mu s$ Typical

mechanical data

The package consists of a gallium arsenide infrared-emitting diode and an n-p-n silicon phototransistor mounted on a 6-lead frame encapsulated within an electrically nonconductive plastic compound. The case will withstand soldering temperature with no deformation and device performance characteristics remain stable when operated in high-humidity conditions. Unit weight is approximately 0.52 grams.



NOTES:

a. Leads are within 0,13 mm (0.005 inch) radius of true position (T.P.) with maximum material condition and unit installed.

b. Pin 1 identified by index dot.

Terminal connections:

1. Anode
2. Cathode } Infrared-emitting diode
3. No internal connection
4. Emitter
5. Collector
6. Base } Phototransistor

FALLS WITHIN JEDEC MO-001AM DIMENSIONS
ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES.

absolute maximum ratings at 25°C free-air temperature (unless otherwise noted)

	TIL112	TIL115	TIL118
Input-to-Output Voltage	±1.5 kV	±2.5 kV	±1.5 kV
Collector-Base Voltage	30 V	30 V	
Collector-Emitter Voltage (See Note 1)	20 V	20 V	20 V
Emitter-Collector Voltage	4 V	4 V	4 V
Emitter-Base Voltage	4 V	4 V	
Input-Diode Reverse Voltage	3 V	3 V	3 V
Input-Diode Continuous Forward Current at (or below) 25°C Free-Air Temperature (See Note 2)	← 100 mA →		
Continuous Power Dissipation at (or below) 25°C Free-Air Temperature:			
Infrared-Emitting Diode (See Note 3)	← 150 mW →		
Phototransistor (See Note 4)	← 150 mW →		
Total (Infrared-Emitting Diode plus Phototransistor, See Note 5)	← 250 mW →		
Storage Temperature Range	← −55°C to 150°C →		
Lead Temperature 1,6 mm (1/16 Inch) from Case for 10 Seconds	← 260°C →		

NOTES: 1. This value applies when the base-emitter diode is open-circuited.
2. Derate linearly to 100°C free-air temperature at the rate of 1.33 mA/°C.
3. Derate linearly to 100°C free-air temperature at the rate of 2 mW/°C.
4. Derate linearly to 100°C free-air temperature at the rate of 2 mW/°C.
5. Derate linearly to 100°C free-air temperature at the rate of 3.33 mW/°C.

electrical characteristics at 25°C free-air temperature

PARAMETER			TEST CONDITIONS†	TIL112 MIN	TIL112 TYP	TIL112 MAX	TIL115 MIN	TIL115 TYP	TIL115 MAX	TIL118 MIN	TIL118 TYP	TIL118 MAX	UNIT
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage		$I_C = 10\ \mu A$, $I_E = 0$, $I_F = 0$	30			30						V
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage		$I_C = 1\ mA$, $I_B = 0$, $I_F = 0$	20			20			20			V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage		$I_E = 10\ \mu A$, $I_C = 0$, $I_F = 0$	4			4						V
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage		$I_E = 10\ \mu A$, $I_F = 0$							4			V
$I_{C(on)}$	On-State Collector Current	Phototransistor Operation	$V_{CE} = 5\ V$, $I_F = 10\ mA$, $I_B = 0$	0.2	2		0.2	2		1	2		mA
		Photodiode Operation	$V_{CB} = 5\ V$, $I_F = 10\ mA$, $I_E = 0$	2	10		2	10					μA
$I_{C(off)}$	Off-State Collector Current	Phototransistor Operation	$V_{CE} = 5\ V$, $I_F = 0$, $I_B = 0$		1	100		1	100		1	100	nA
		Photodiode Operation	$V_{CB} = 5\ V$, $I_F = 0$, $I_E = 0$		0.1	50		0.1	50				nA
h_{FE}	Transistor Static Forward Current Transfer Ratio		$V_{CE} = 5\ V$, $I_C = 10\ mA$, $I_F = 0$	50	200		50	200					
V_F	Input Diode Static Forward Voltage		$I_F = 10\ mA$		1.2	1.5		1.2	1.5		1.2	1.5	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		$I_C = 2\ mA$, $I_F = 50\ mA$, $I_B = 0$			0.5			0.5			0.5	V
r_{IO}	Input-to-Output Internal Resistance		$V_{in\text{-}out} = \pm 1.5\ kV$, See Note 6	10^{11}						10^{11}			Ω
			$V_{in\text{-}out} = \pm 2.5\ kV$, See Note 6				10^{11}						Ω
C_{io}	Input-to-Output Capacitance		$V_{in\text{-}out} = 0$, $f = 1\ MHz$, See Note 6		1	2		1	2		1	2	pF

NOTE 6: These parameters are measured between both input-diode leads shorted together and all the phototransistor leads shorted together.
† References to the base are not applicable for the TIL118.

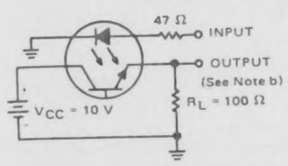
switching characteristics at 25°C free-air temperature

PARAMETER			TEST CONDITIONS	TIL112 MIN	TIL112 TYP	TIL112 MAX	TIL115 MIN	TIL115 TYP	TIL115 MAX	TIL118 MIN	TIL118 TYP	TIL118 MAX	UNIT
t_r	Rise Time	Phototransistor Operation	$V_{CC} = 10\ V$, $I_{C(on)} = 2\ mA$, $R_L = 100\ \Omega$, See Test Circuit A of Figure 1		2	15		2	15		2	15	μs
t_f	Fall Time				2	15		2	15		2	15	μs
t_r	Rise Time	Photodiode Operation	$V_{CC} = 10\ V$, $I_{C(on)} = 20\ \mu A$, $R_L = 1\ k\Omega$, See Test Circuit B of Figure 1		1			1					μs
t_f	Fall Time				1			1					μs

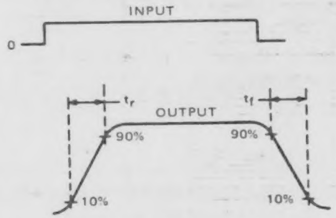
1173

PARAMETER MEASUREMENT INFORMATION

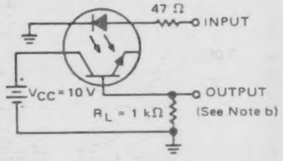
Adjust amplitude of input pulse for:
$I_{C(on)} = 2\ mA$ (Test Circuit A) or
$I_{C(on)} = 20\ \mu A$ (Test Circuit B)



TEST CIRCUIT A
PHOTOTRANSISTOR OPERATION



VOLTAGE WAVEFORMS



TEST CIRCUIT B
PHOTODIODE OPERATION

NOTES: a. The input waveform is supplied by a generator with the following characteristics: $Z_{out} = 50\ \Omega$, $t_r \leq 15\ ns$, duty cycle ≈ 1%, $t_w = 100\ \mu s$.
b. The output waveform is monitored on an oscilloscope with the following characteristics: $t_r \leq 12\ ns$, $R_{in} \geq 1\ M\Omega$, $C_{in} \leq 20\ pF$.

FIGURE 1–SWITCHING TIMES

TYPICAL CHARACTERISTICS

COLLECTOR CURRENT
vs
COLLECTOR-EMITTER VOLTAGE

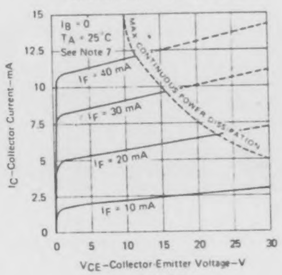


FIGURE 2

COLLECTOR CURRENT
vs
INPUT-DIODE FORWARD CURRENT

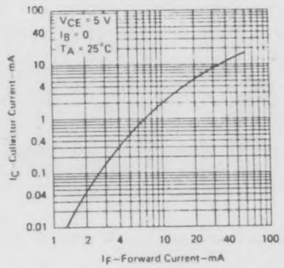


FIGURE 3

RELATIVE ON-STATE COLLECTOR CURRENT
vs
FREE-AIR TEMPERATURE

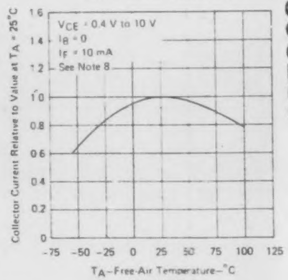


FIGURE 4

NOTES: 7. Pulse operation of input diode is required for operation beyond limits shown by dotted lines.
8. These parameters were measured using pulse techniques $t_w = 1\ ms$, duty cycle ≤ 2%.

1173

TYPICAL CHARACTERISTICS

OFF-STATE COLLECTOR CURRENT
vs
FREE-AIR TEMPERATURE

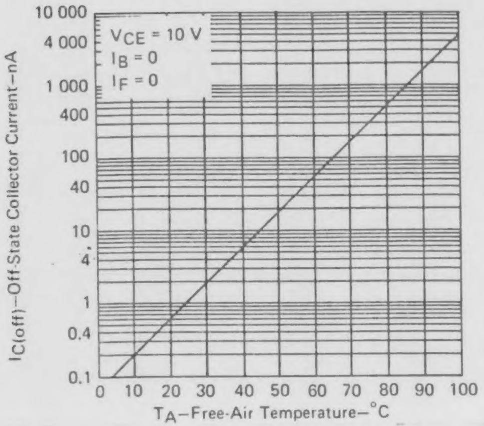


FIGURE 5

NORMALIZED TRANSISTOR STATIC FORWARD CURRENT TRANSFER RATIO
vs
ON-STATE COLLECTOR CURRENT

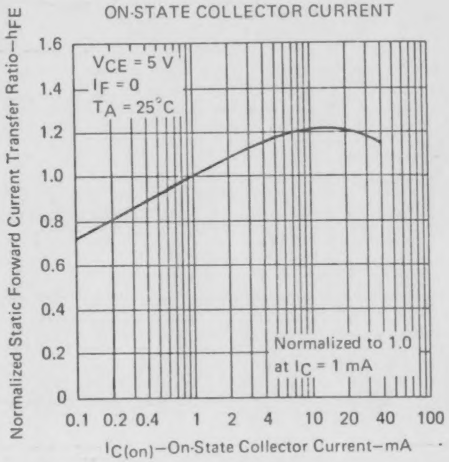


FIGURE 6

INPUT DIODE FORWARD
CONDUCTION CHARACTERISTICS

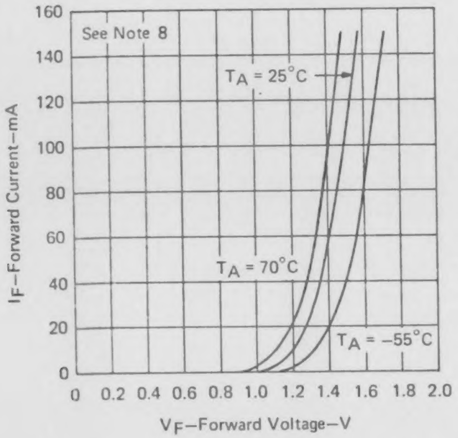


FIGURE 7

COLLECTOR CURRENT
vs
MODULATION FREQUENCY

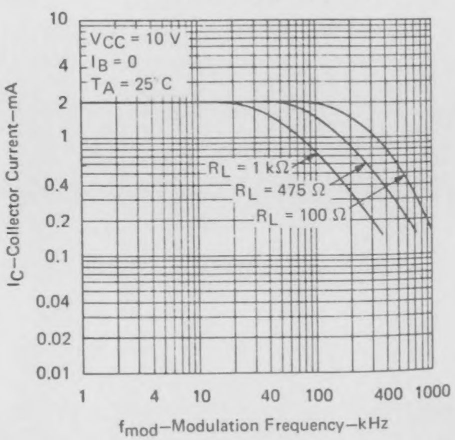


FIGURE 8

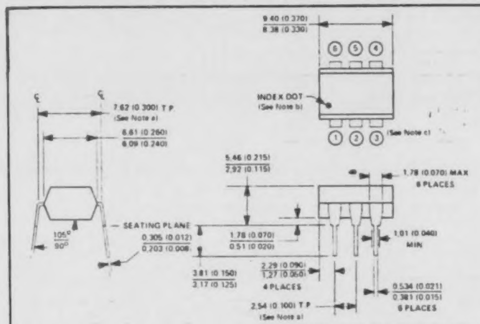
NOTE 8: These parameters were measured using pulse techniques. t_w = 1 ms, duty cycle ≤ 2%.

D1499, AUGUST 1981–REVISED FEBRUARY 1983

- Gallium Arsenide Diode Infrared Source Optically Coupled to a Silicon N-P-N Darlington-Connected Phototransistor
- High Direct-Current Transfer Ratio . . . 300% Minimum at 10 mA
- High-Voltage Electrical Isolation . . . 1500-Volt Rating
- Plastic Dual-In-Line Package
- Base Lead Provided on TIL113 for Conventional Transistor Biasing
- No Base Lead Connection on TIL119A for High-EMI Environments
- Typical Applications Include Remote Terminal Isolation, SCR and Triac Triggers, Mechanical Relays, and Pulse Transformers

mechanical data

The package consists of a gallium arsenide infrared-emitting diode and an n-p-n silicon darlington-connected phototransistor mounted on a 6-lead frame encapsulated within an electrically nonconductive plastic compound. The case will withstand soldering temperature with no deformation and device performance characteristics remain stable when operated in high-humidity conditions. Unit weight is approximately 0.52 grams.



NOTES

a. Leads are within 0,13 mm (0.005 inch) radius of true position (T.P.) with maximum material condition and unit installed.

b. Pin 1 identified by index dot.

Terminal connections:

1. Anode
2. Cathode
3. No internal connection
4. Emitter
5. Collector
6. TIL113 base
   TIL119 base or no internal connection at the option of TI
   TIL119A no internal connection

(1–2: Infrared-emitting diode; 4–6: Photo-transistor)

FALLS WITHIN JEDEC MO-001AM DIMENSIONS
ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

absolute maximum ratings at 25°C free-air temperature (unless otherwise noted)

Input-to-Output Voltage	±1.5 kV
Collector-Base Voltage (TIL113)	30 V
Collector-Emitter Voltage (See Note 1)	30 V
Emitter-Collector Voltage	7 V
Emitter-Base Voltage (TIL113)	7 V
Input-Diode Reverse Voltage	3 V
Input-Diode Continuous Forward Current at (or below) 25°C Free-Air Temperature (See Note 2)	100 mA
Continuous Power Dissipation at (or below) 25°C Free-Air Temperature:	
Infrared-Emitting Diode (See Note 3)	150 mW
Phototransistor (See Note 4)	150 mW
Total (Infrared-Emitting Diode plus Phototransistor, See Note 5)	250 mW
Storage Temperature Range	–55°C to 150°C
Lead Temperature 1,6 mm (1/16 Inch) from Case for 10 Seconds	260°C

NOTES:
1. This value applies when the base-emitter diode is open-circuited.
2. Derate linearly to 100°C free-air temperature at the rate of 1.33 mA/°C.
3. Derate linearly to 100°C free-air temperature at the rate of 2 mW/°C.
4. Derate linearly to 100°C free-air temperature at the rate of 2 mW/°C.
5. Derate linearly to 100°C free-air temperature at the rate of 3.33 mW/°C.